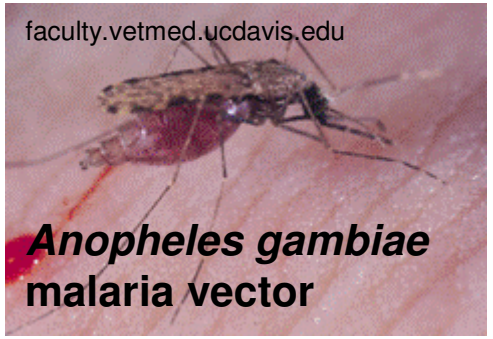
Factors affecting the size of a mosquito population in a favourable environment

P. Cailly[1], A. Tran[2], T. Balenghien[3], C. Toty[4,5], P. Ezanno[1]

[1]INRA,Oniris, UMR1300 Bio-agression, Epidémiologie et Analyse de Risques,
[2]CIRAD, UPR AGIRs Animal et Gestion Intégrée des Risques,
[3]CIRAD, UMR Contrôle des maladies,
[4]IRD, UR016 Caractérisation et Contrôle des Populations de Vecteurs,
[5]Centre de Recherche et de Veille sur les maladies émergentes dans l'Océan Indien

Why mosquitoes?

- Pathogenic agents of major vector born diseases
  - viruses (e.g. West Nile virus), parasites (e.g. *Plasmodium falciparum*)
  - largely distributed across the world
  - public health & animal health
  - health, ecological, socioeconomic & political consequences



➔ active vectors necessary for the epidemiological cycle of these diseases

Why mosquitoes?

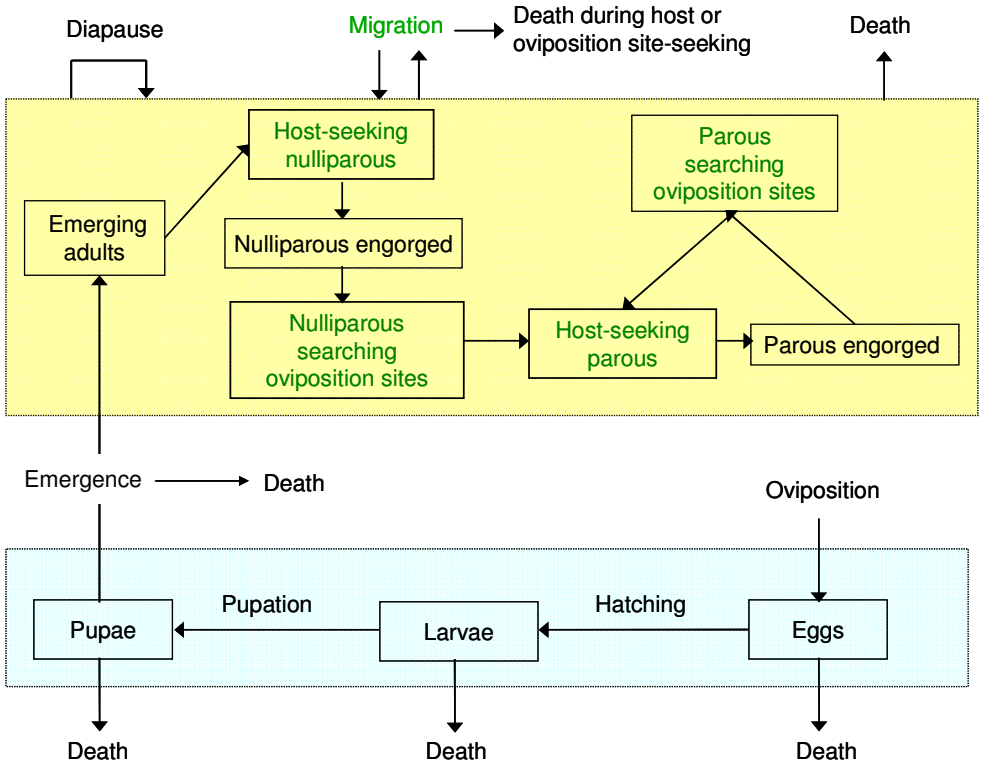
- Efficient anti-vector fight strategies require to well know:
  - mosquito life cycle & behaviour
  - related to their biotope (breeding site, ...)
  - related to the variation of climatic factors (temperature, humidity, …)
- Mosquitoes brave these strategies up to now: malaria and dengue do not weaken
- An integrative approach by modelling proves to be necessary for better:
  - understanding the dynamics of a mosquito vector population
  - describing the mosquito abundance
  - identifying the most influential parameters = potential control points of the population

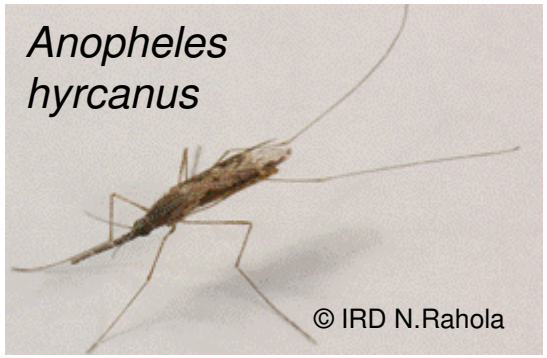
Objective

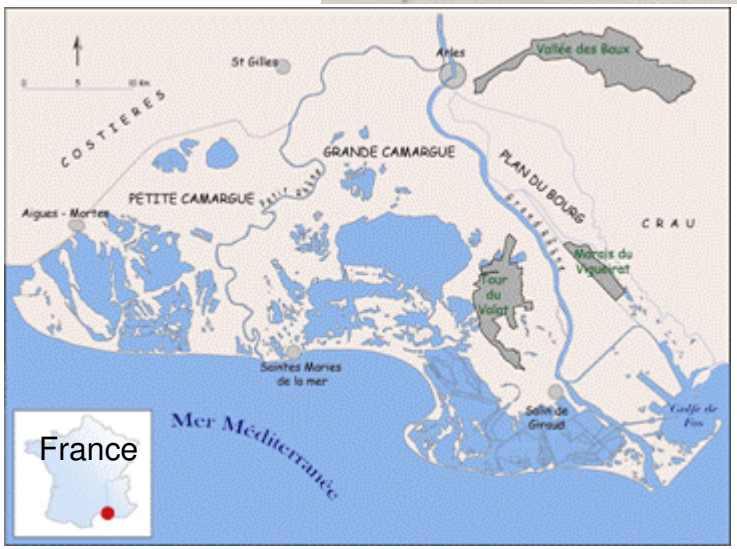
Identifying by modelling the factors affecting the size of a mosquito population located in a favourable environment

Modelling approach

- Mechanistic model
- Adapted to *Anopheles* of Camargue region, France
- Driven by climate
- Lasting several years







Modelling approach

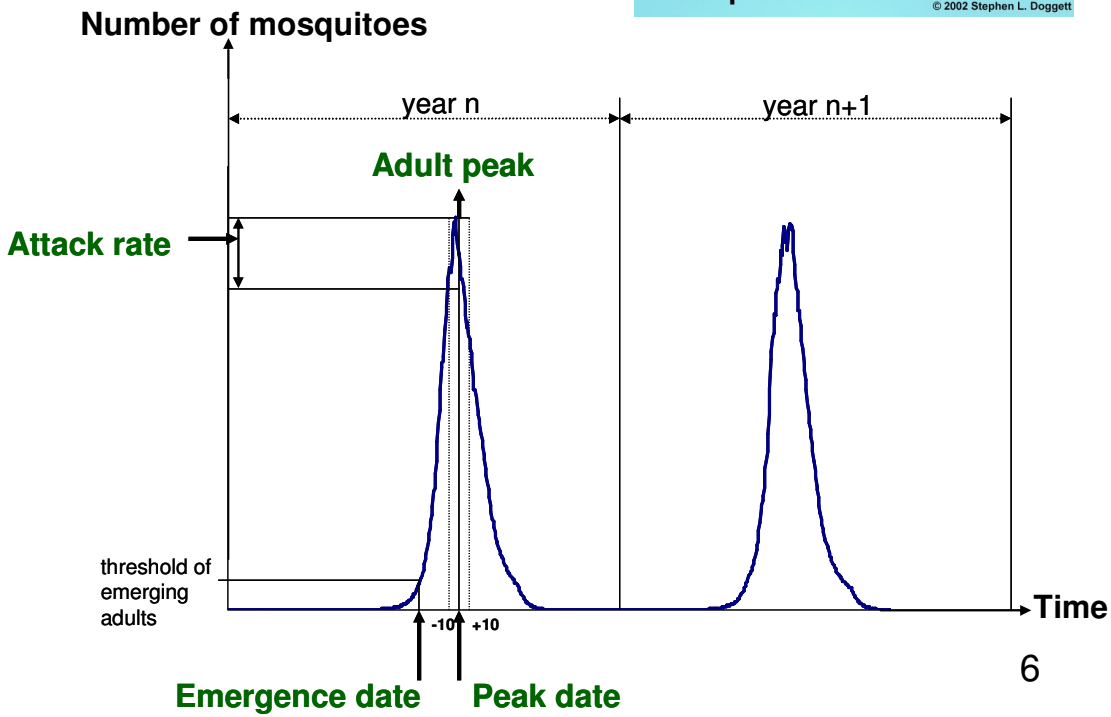
- Nulliparous into diapause during winter
- Development parameters

& mortality rates depend on temperature

- Model output
  - General output:

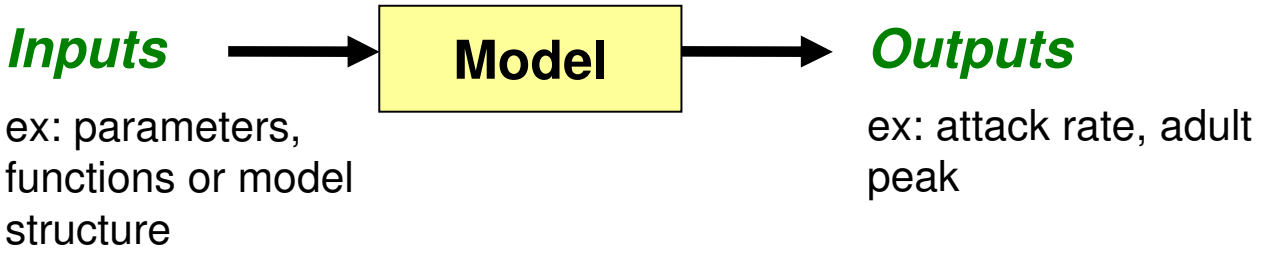
    Dynamic abundance in adults over time

  - Aggregated output:



Sensitivity analysis of the model

- Quantify the influence of input values on the outputs



- describe the model parameters for which the model is the most sensitive

  ➔Influent parameters are potential control points of the biological system

- Confront different methods to identify influential parameters in a robust way

EID MÉDITERRANÉE
OPÉRATEUR PUBLIC EN ZONES HUMIDES

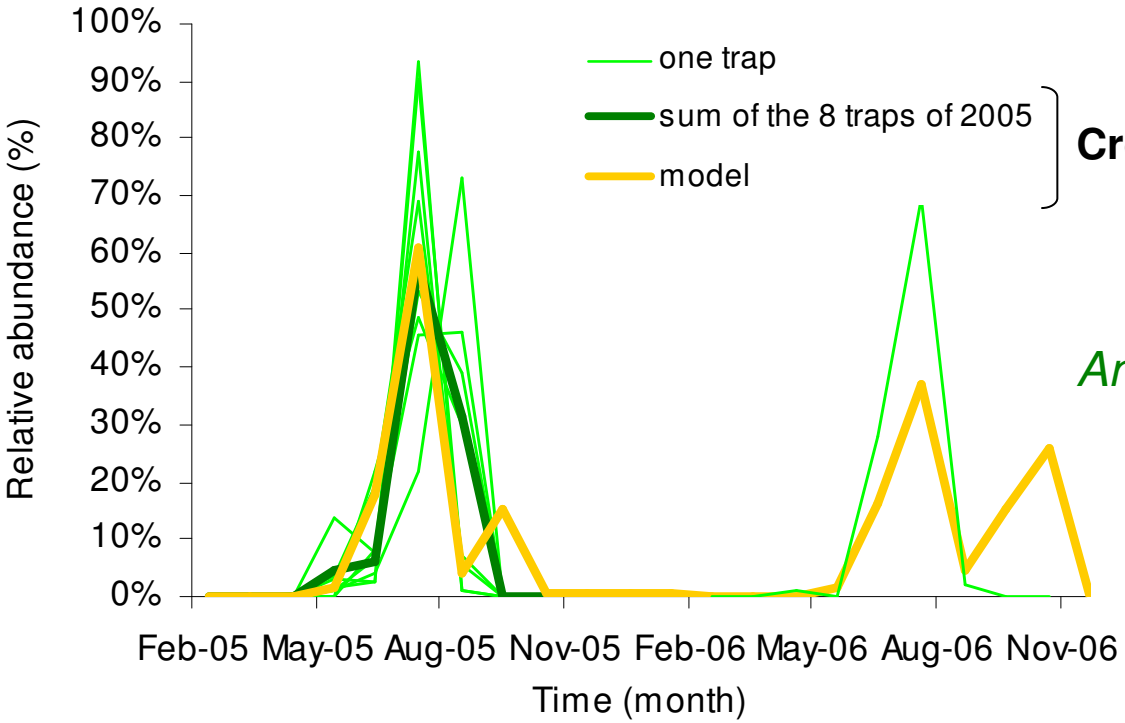
G. L'Ambert

IRD
Institut de recherche pour le développement

C.Toty

Results

- Model confrontation to independent field data
  - Number of host-seeking females



Cross-correlation=0.8

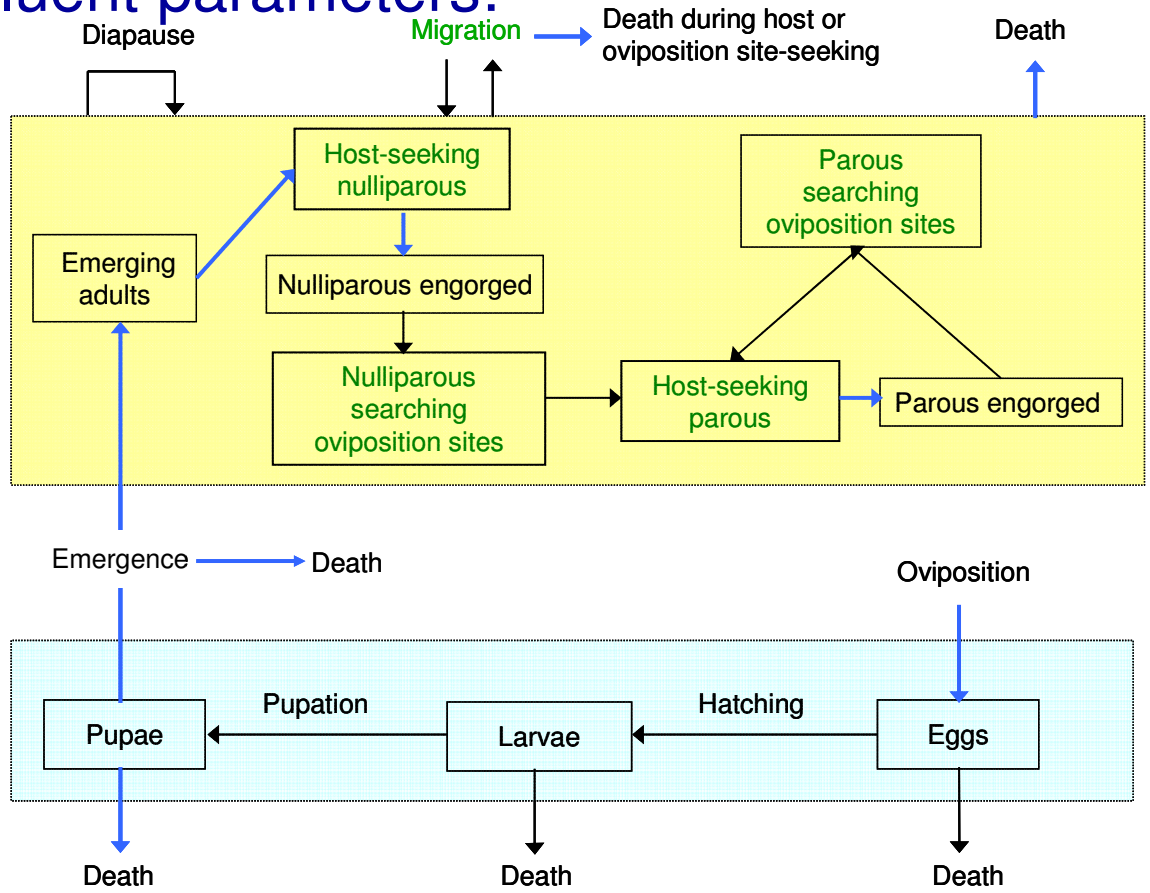
An. hyrcanus a favourable area

➔ Our model predicts correctly a mean dynamics of mosquito populations

Results

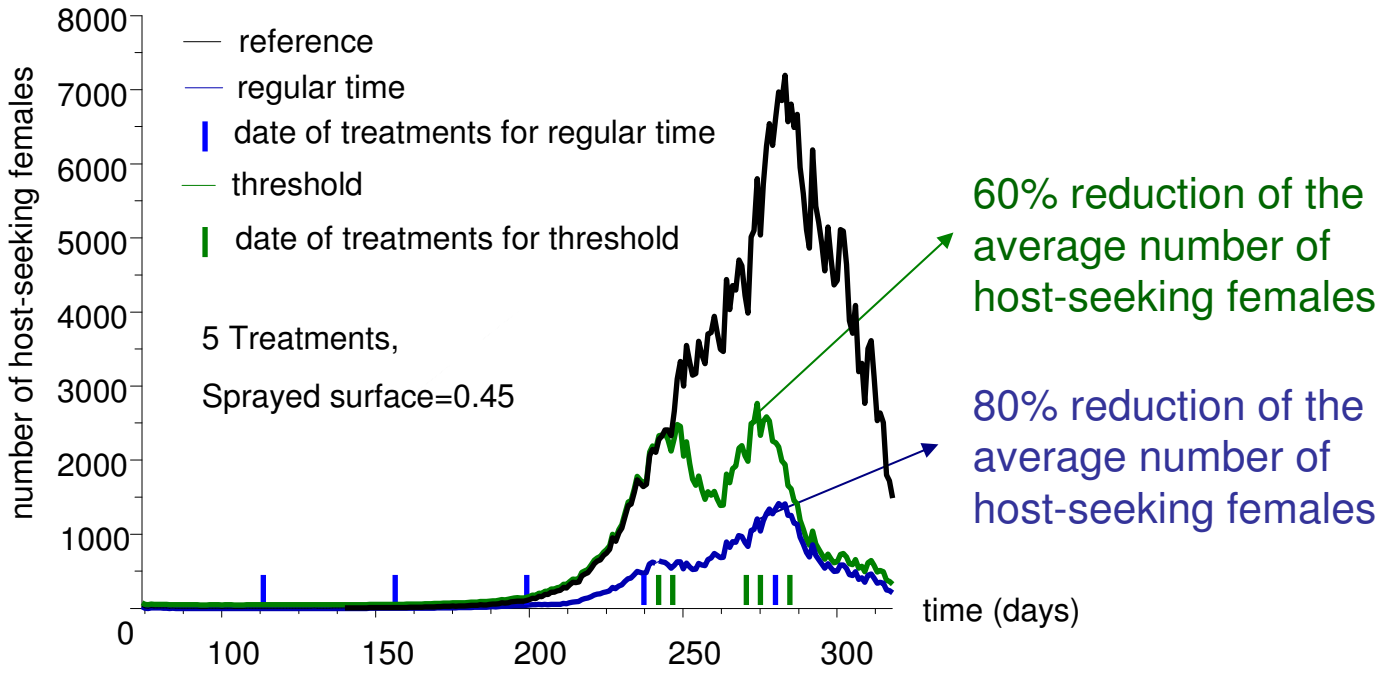
Sensitivity analysis

- No interaction
- Influent parameters:



Scenario of control strategies

- Bio-larvicide, similar to Bti, persistent during 7 days
- Different proportions of the sprayed surface & 2 strategies tested
  - Sprayed at regular time intervals
  - Sprayed when mosquito abundance exceeds a threshold value

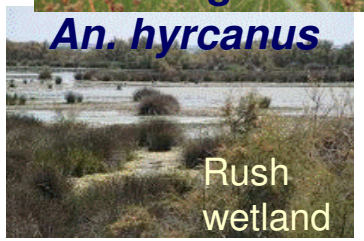


Discussion & perspectives

- Contribution of our model of mosquito population dynamics
  - Knowing the influential parameters of the model orientates future research efforts on the control of mosquitoes
  - The model is a tool to test control strategies
- Valid results for a homogeneous environment
  - Not restricted in hosts, rest shelters, breeding sites
- Environmental factors can be heterogeneous

  ➔ Population can be spatially structured
- In these conditions:

  ➔ Spatial model is the next step



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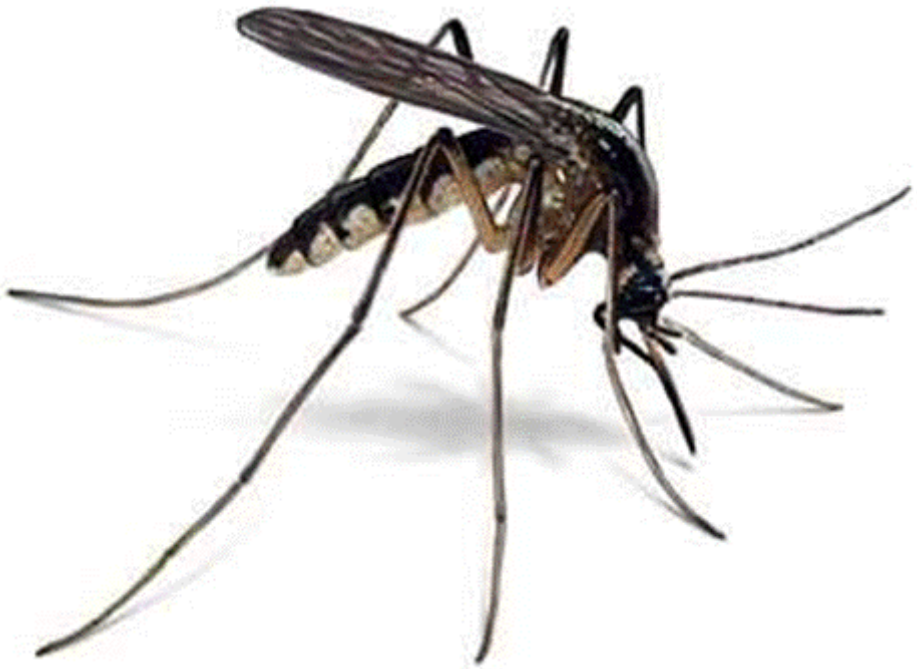
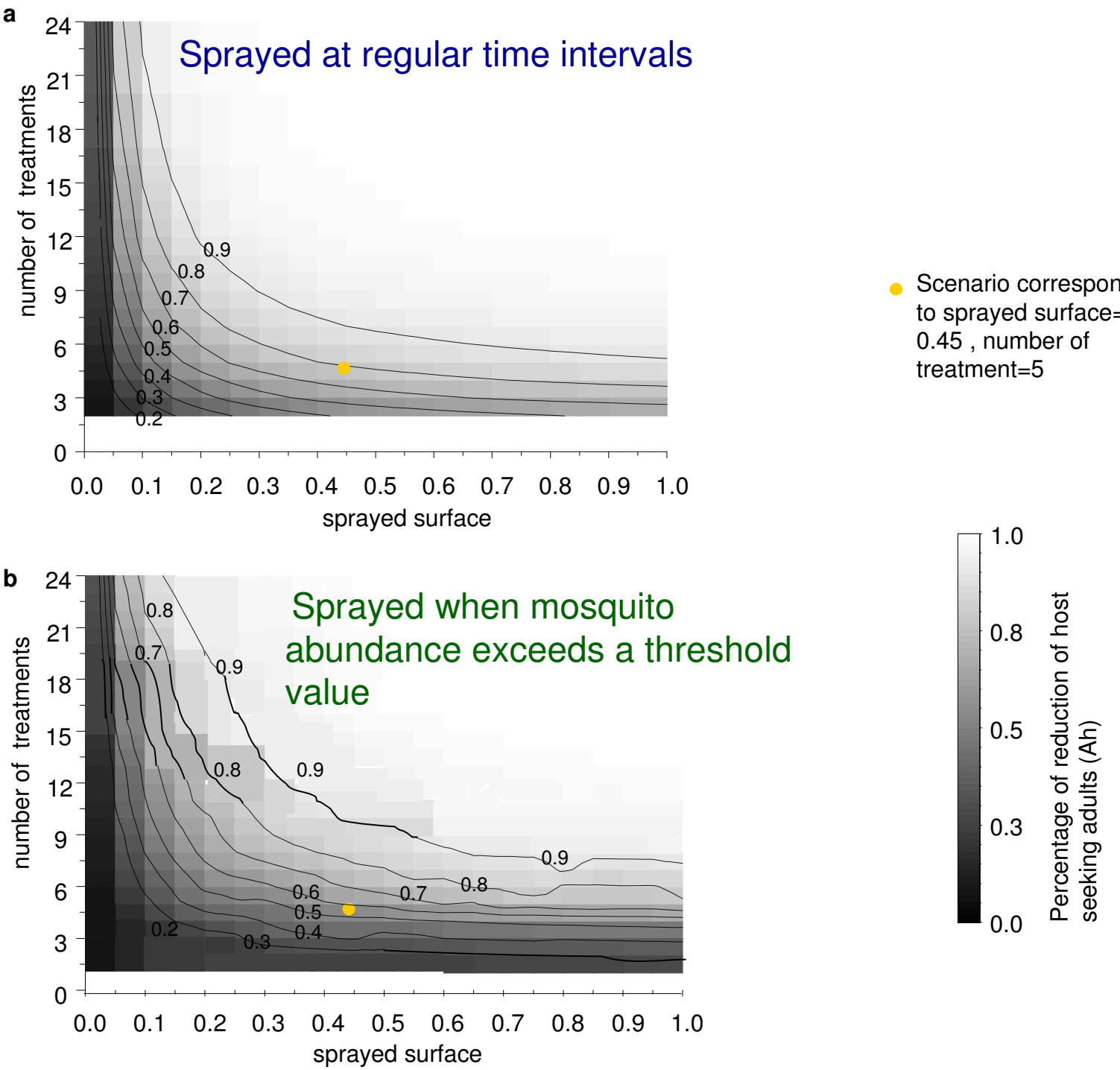


Questions?


a
Sprayed at regular time intervals
number of treatments
sprayed surface
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
Scenario corresponding to sprayed surface= 0.45 , number of treatment=5
b
Sprayed when mosquito abundance exceeds a threshold value
Percentage of reduction of host seeking adults (Ah)
1.0
0.8
0.5
0.3
0.0